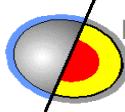


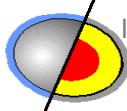
ERA40 Dynamical Downscaling

Bodo Ahrens, Alexander Beck
Institut für Meteorologie und Geophysik, Universität Wien
e-mail: Bodo.Ahrens@univie.ac.at



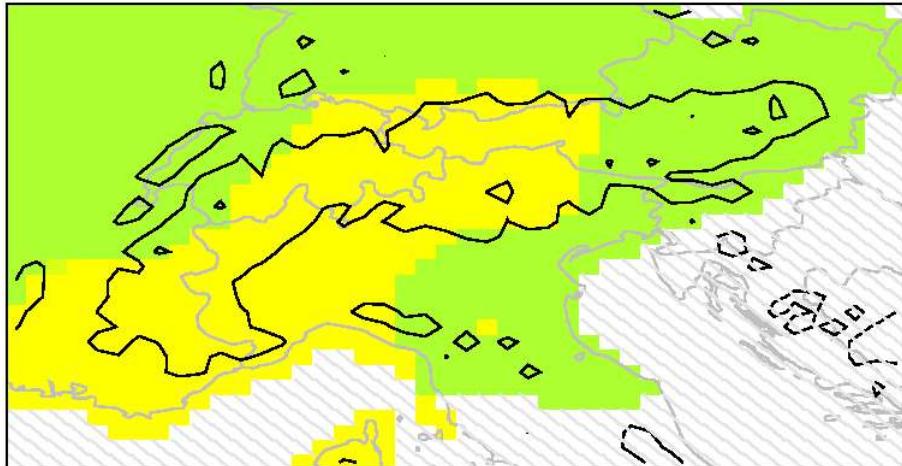
Motivation

- High-resolution Alpine climate description
(daily, $Dx \sim 10\text{km}$)
- Training input for climate impact models
- Test-bed for ECHAM DDS

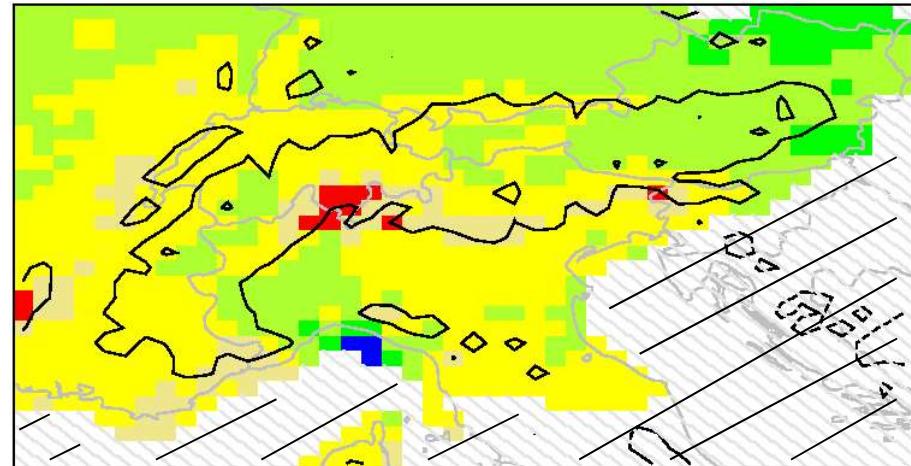


MAP SOP precipitation

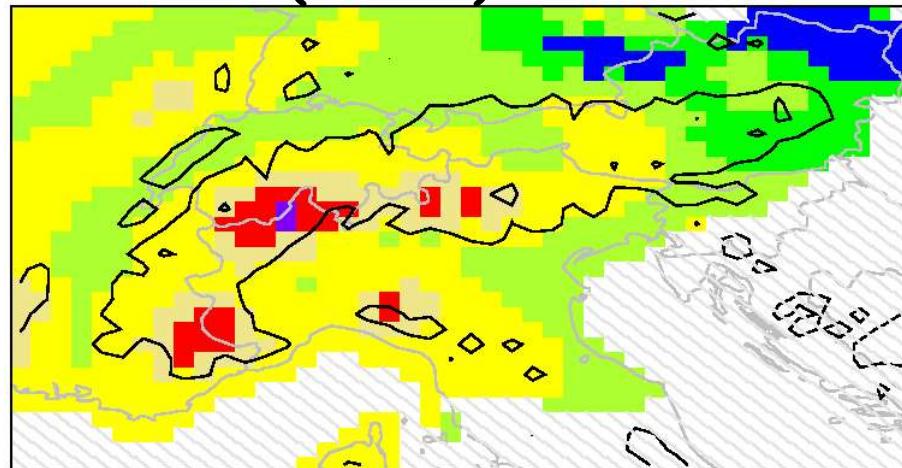
ERA40 (mesh size ~120km)



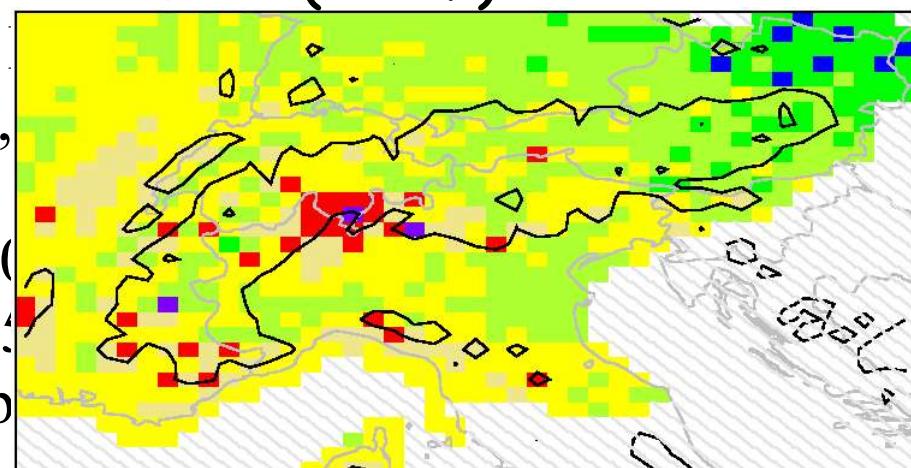
Frei & Haeller (2001) analysis



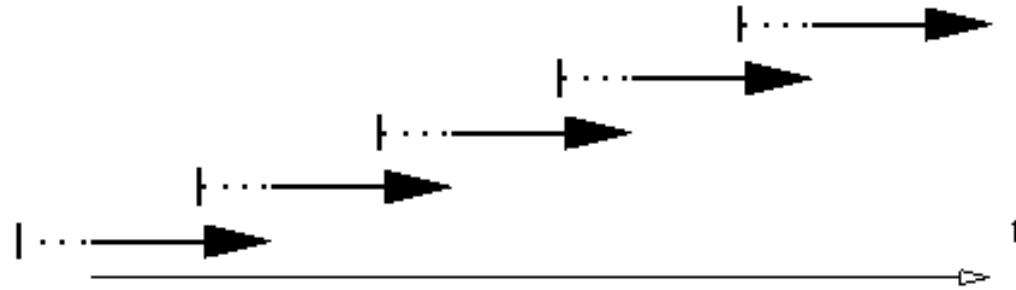
ALADIN (50km)



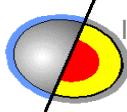
ALADIN (12km)



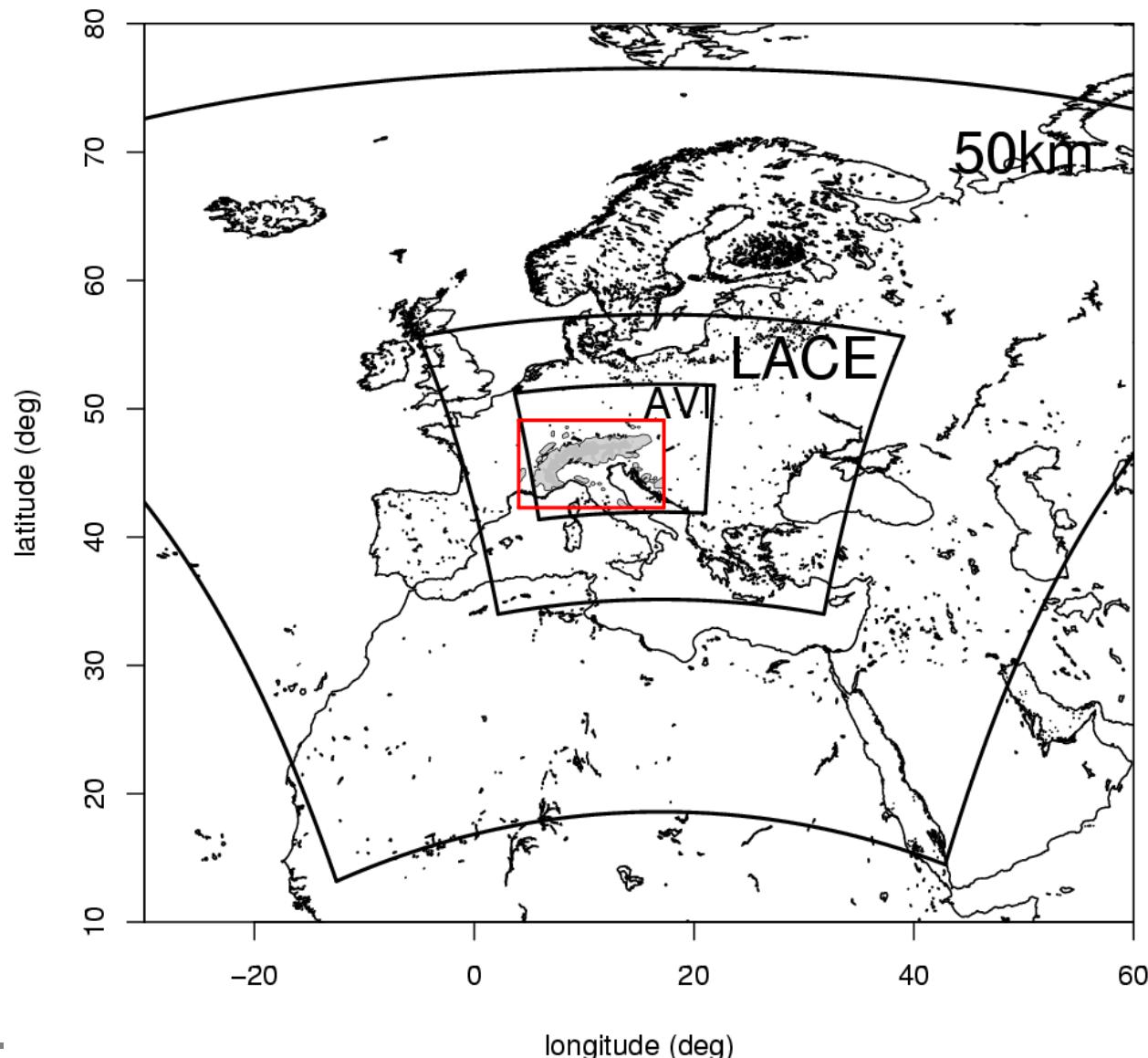
Sequence of hindcasts



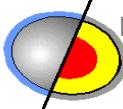
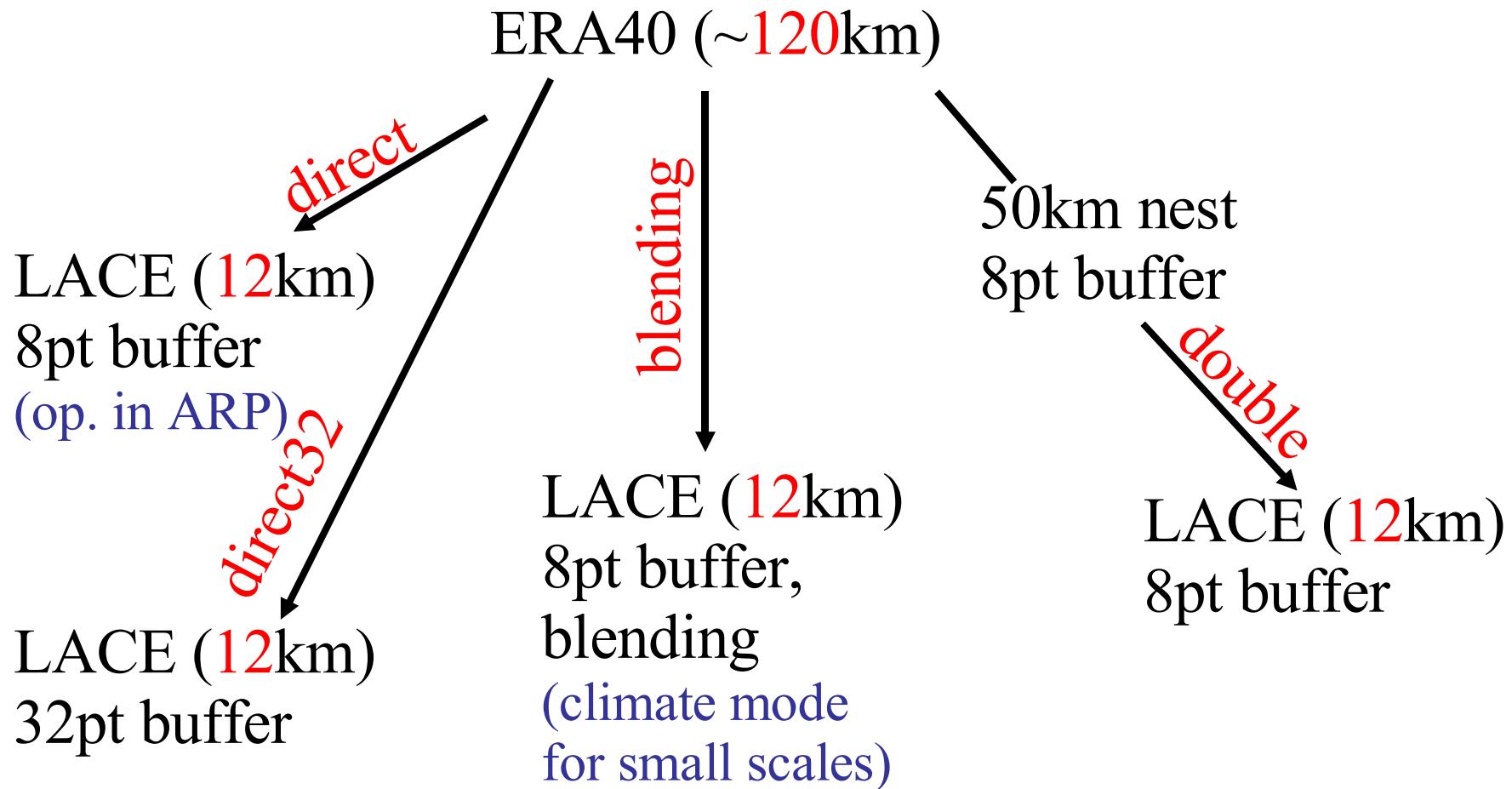
- 30h hindcasts, 6h coupling time step
- discarding the first 6h (model spin up)
- one-way nesting
 - e.g. 12km nest directly in 120km ERA40 => a scale jump of a factor of 10



The problem: Optimal nesting strategy?



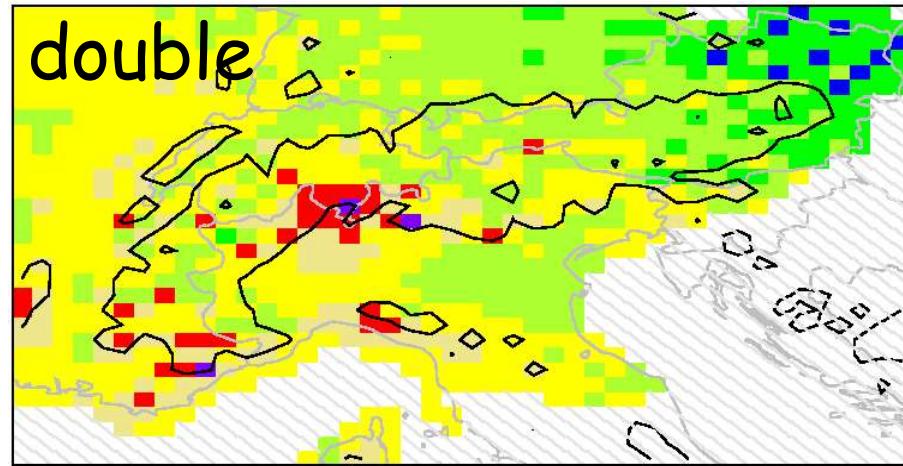
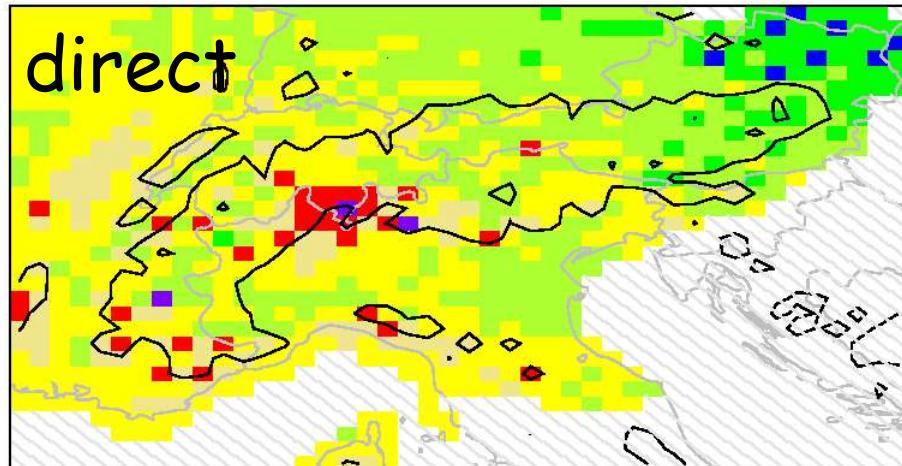
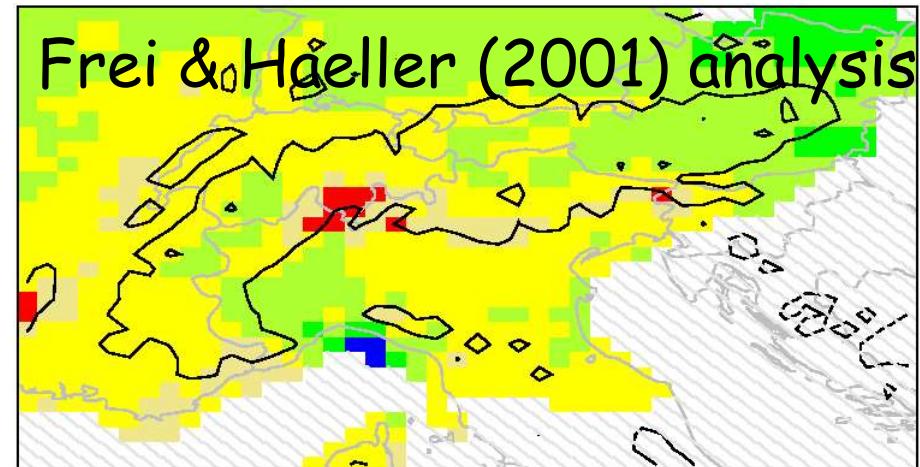
Nesting Strategies



Impact of Nesting Configuration

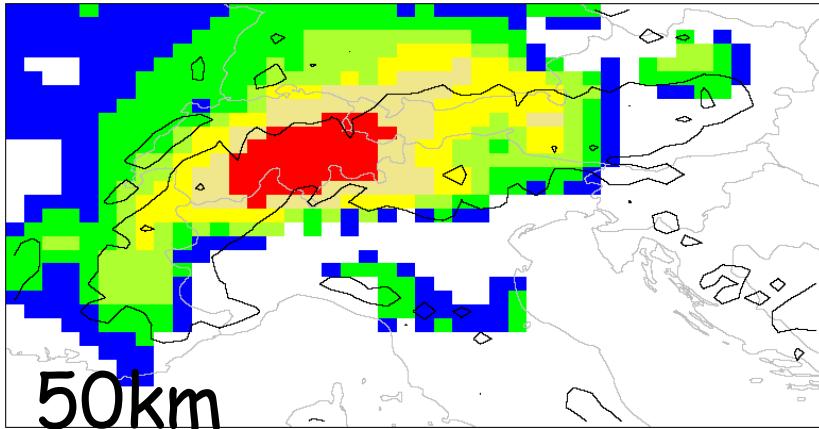
bias:
(mm/d)

ERA40	-1.03
direct	0.22
direct32	0.06
blending	0.26
double	0.19

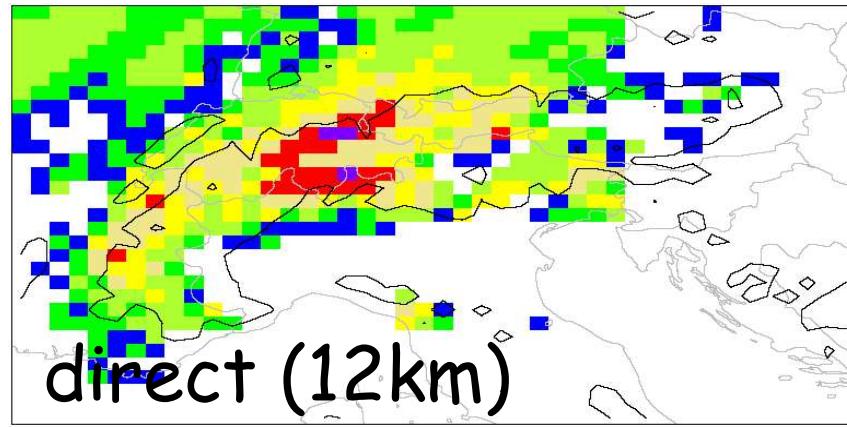


Resolution Effects

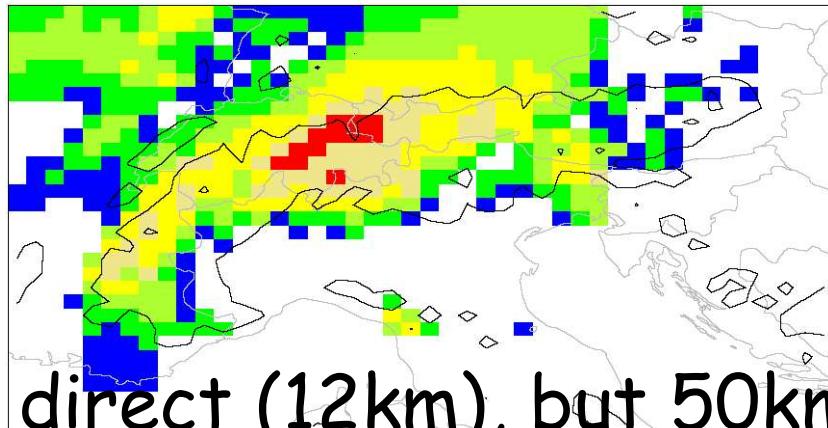
26 Sep. 1999 precipitation



50km

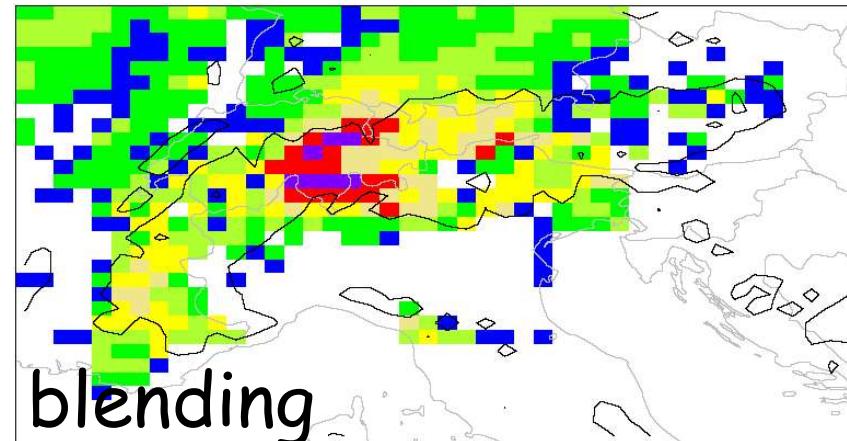
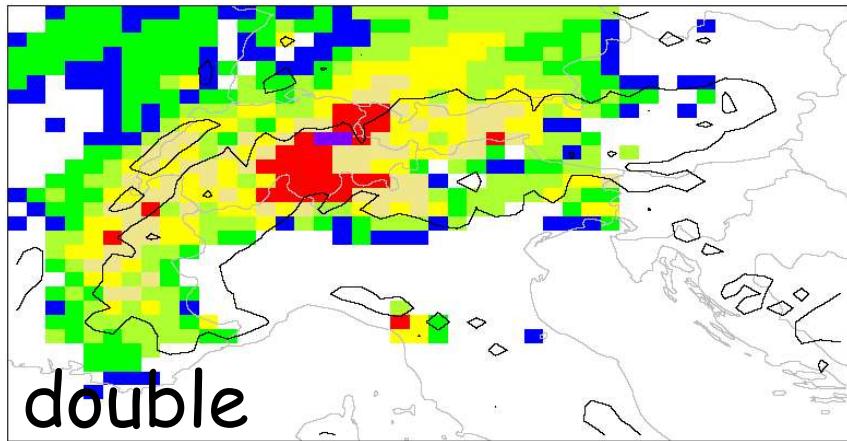
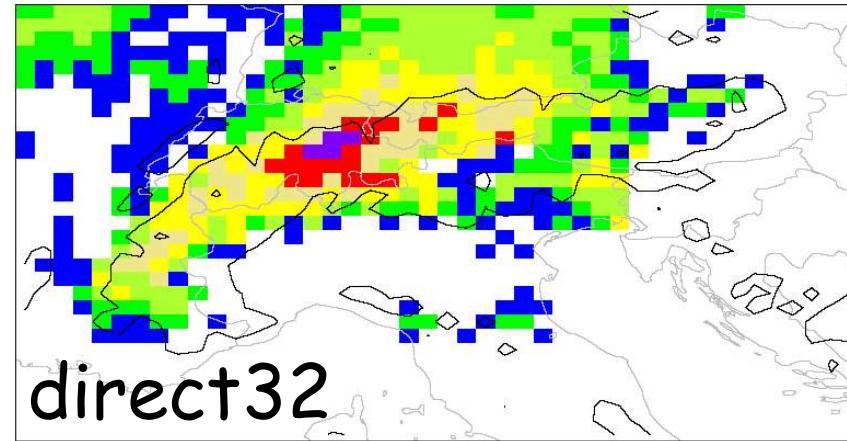
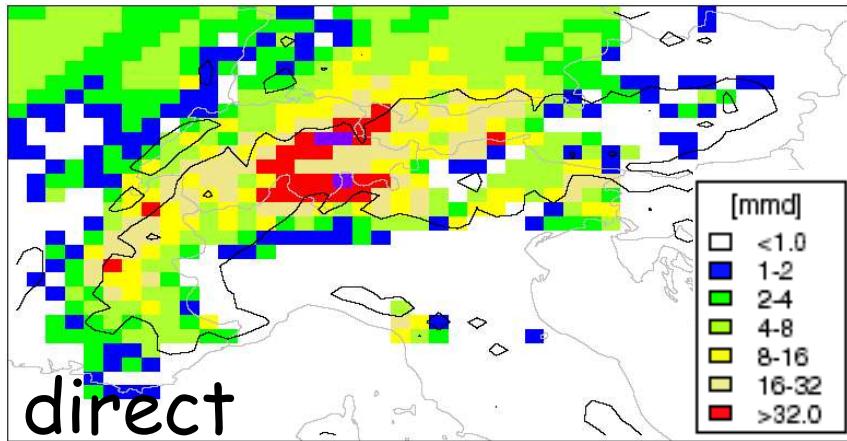


direct (12km)



direct (12km), but 50km orography

12 km Nests



Statistics

100 km 1day	bias [mm/d]	SPREX [1]	SPRET [1]	R^2_X [1]	R^2_T [1]
direct	0.22	1.50	1.16	0.51	0.67
direct32	0.06	1.54	1.10	0.49	0.67
double	0.19	1.58	1.08	0.48	0.66
blending	0.26	1.56	1.10	0.54	0.67
50 km	-0.06	1.35	1.04	0.46	0.66
ERA40	-1.03	0.48	0.59	0.33	0.52

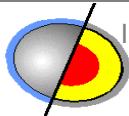
SPREX: temporal mean of ratios of spatial field variances

SPRET: spatial mean of ratios of pixel time series variances

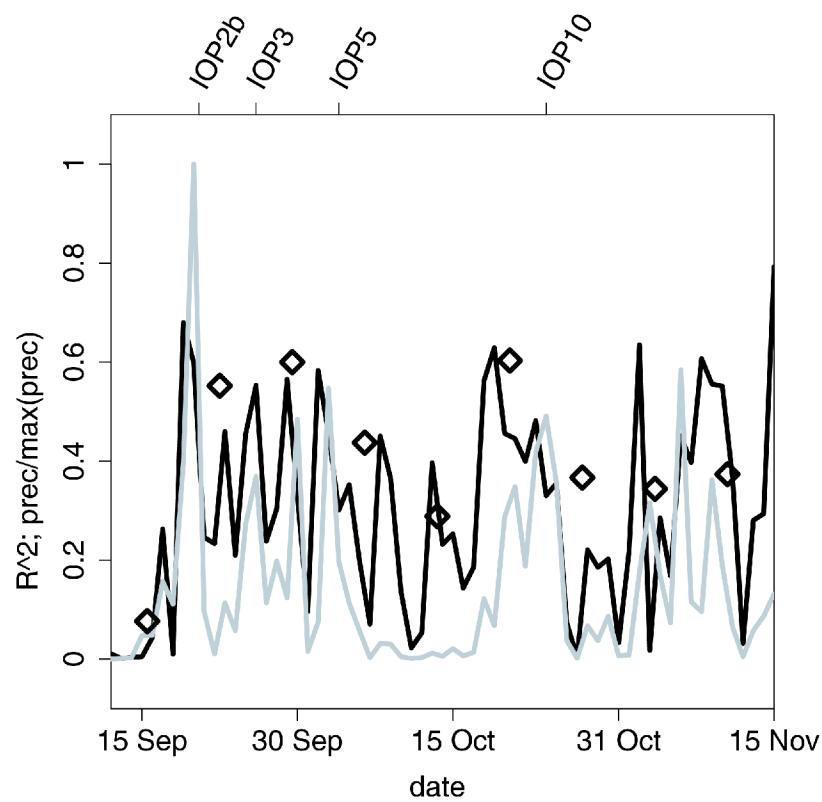
R^2_X : temporal mean of squared spatial field correlations

R^2_T : spatial mean of squared time series correlations

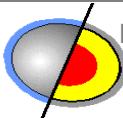
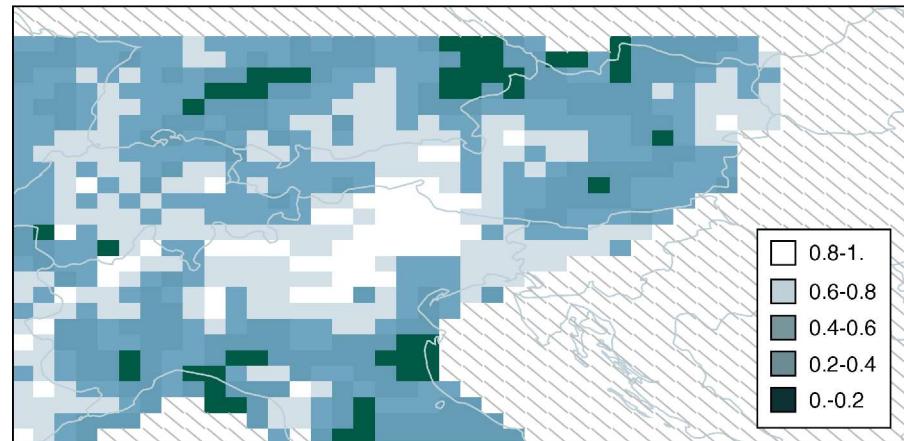
⇒ other errors are more important than differences due to nesting strategy



Pattern of R^2_X



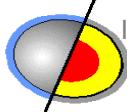
Pattern of R^2_T



Statistics

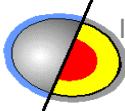
ref. FH analysis	SPREX [1]	SPRET [1]	R_X^2 [1]	R_T^2 [1]
eddy 50→100				
direct	1.45	1.48	0.19	0.24
direct32	1.28	1.34	0.17	0.24
double	1.38	1.41	0.16	0.23
blending	1.46	1.47	0.20	0.25
eddy 25→50				
direct	2.13	2.16	0.07	0.16
direct32	2.01	2.26	0.04	0.16
double	1.99	2.00	0.05	0.15
blending	2.30	2.29	0.07	0.16

Performance or evaluation problem below 100km?



Conclusions

- Precipitation patterns at 1d/100km scale are better represented in ALADIN-12km than in ERA40-120km simulations.
- Nesting configuration not crucial despite the large resolution jump (factor 10), especially double nesting not necessary - “There are other problems!”
- Continuous blending (= spectral nudging) seems to be promising, but expensive!?



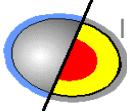
Outlook

Direct nesting => DDS, but no regional climate due to lack of memory!

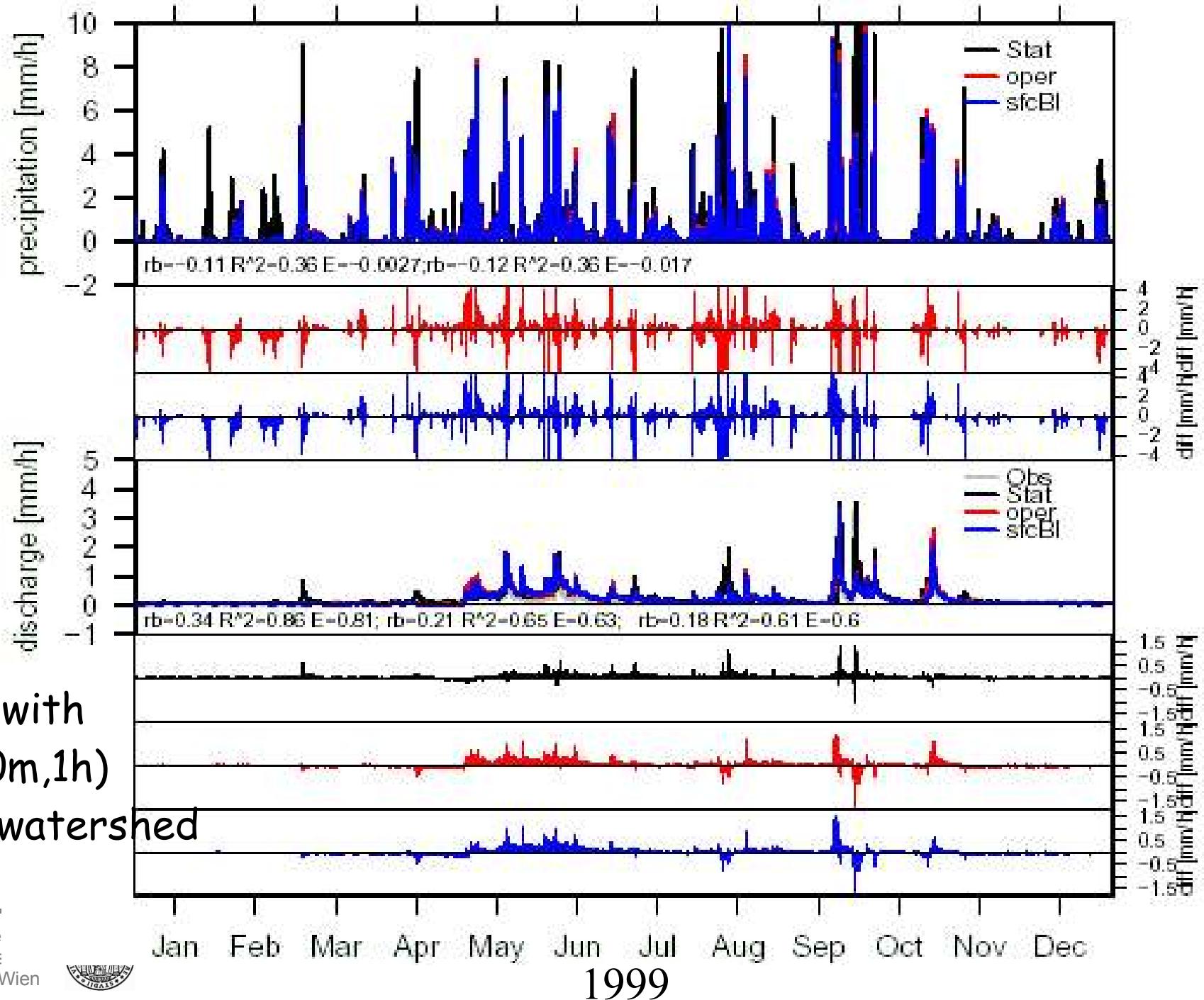
0.5 step into "climate simulation": Surface blending, i.e. relaxation of ISBA sfc. to TESSEL sfc.

Implementation and test by Jure C. (for MAP SOP):

- 90% blending better than 97% or no blending
(-> memory is good & ERA40 sfc assimilation too!)
- 100% blending (no reinitialization) worst
(died in a 1999 sim. -> climate ISBA,
improved radiation scheme)



NO vs 97% blending



Why with ALADIN?

- Operational in Austria and most neighbors
- Packaged and phased with ARPEGE/IFS and closely related with ARPEGE-CLIMATE - Will this prevail??

